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Taking gambles at face value:

Effects of emotional expressions on risky decisions

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Abstract

Emotional facial expressions are ubiquitous yet potent social stimuli that can signal favorable and unfavorable conditions. Previous research demonstrates that emotional expressions influence simple preference judgments and basic approach-avoidance behaviors. Here, we examined whether emotional expressions can influence complex decisions such as choices between gambles. Based on theoretical models of affective cue processing, we predicted greater risk taking after positive than negative expressions. This hypothesis was tested across three tasks that varied in implementation of risks, payoffs, probabilities, and temporal decision requirements. In all three tasks, the likelihood of a risky choice was greater after exposure to positive versus negative expressions. Similar effects on risky choice occurred after presentation of different negative expressions (e.g., fear vs. anger), suggesting involvement of general positive and negative affect systems. These results highlight that incidental socioemotional cues have a valence-specific influence of on decisions, and have important implications for risk-taking behavior in social situations.

The question of how emotions influence decisions has a long history in psychology, going back to Darwin who conceptualized emotions as adaptations that facilitate fitness-enhancing choices. In his treatise on emotional facial expressions, Darwin suggested that negative expressions, such as fear or anger, signal unfavorable conditions whereas positive expressions, such as happiness, signal favorable conditions (Darwin, 1872). Here, we examine whether exposure to emotional facial expressions can influence people's risky decisions. Following current theoretical models that emphasize a valenced (positive-negative) organization of responses to affective cues, we predict that participants will be more willing to take a risky gamble after exposure to positive expressions than exposure to negative expressions. This hypothesis has implications for our understanding of emotions, decisions, and the connection between them.

Effects of Emotional Facial Expressions

Emotional facial expressions are ubiquitous, potent, and highly familiar social stimuli (Ekman, 1984). The processing of facial expressions can occur implicitly, even when they are irrelevant to the task, such as when participants classify faces on gender (Critchley et al., 2000; Oehman, Flykt, & Lundqvist, 2000). Implicitly processed expressions can influence a variety of affective responses, ranging from simple preference judgments to immediate approach-avoidance behaviors. For instance, after a brief presentation of a happy face, as opposed to an angry face, participants rate novel stimuli more favorably, and consume more of a novel drink (Murphy & Zajonc, 1993; Niedenthal, 1990; Winkielman, Berridge, & Wilbarger, 2005a). Interestingly, the influence of facial expressions occurs regardless of whether they change subjective feelings, suggesting mediation via relatively direct mechanisms rather than inferences from feelings (Schwarz & Clore, 2003; Winkielman, Zajonc, & Schwarz, 1997). Furthermore, the effects of

implicit emotional expressions are differentiated primarily on general positive-negative valence, rather than emotion quality (Zajonc, 2000). For example, implicit exposure to different negative expressions, such as anger vs. fear, leads to similar decreases in preference and triggers similar physiological responses (Winkielman et al., 2005b).

Theoretical accounts of these findings propose that implicitly processed emotional cues, such as facial expressions, initially activate the core affect systems responsible for a general positive-negative modification of behavior (Cacioppo & Berntson, 1999; Hamm, Schupp, & Weike, 2003; Lang, 1995; Panksepp, 1998; Russell, 2003; Zajonc, 2000). Specifically, happy expressions that signal a favorable environment activate the positive affect system, whereas fearful or angry expressions that signal an unfavorable environment activate the negative affect system, with more differentiated reactions requiring additional processing of the expression and its situational context. Interestingly, these theoretical accounts also highlight that the positive affect system promotes exploration, whereas the negative affect system promotes caution (Cacioppo & Berntson, 1999). These considerations suggest that implicit exposure to positive expressions should temporarily promote risk-seeking whereas exposure to negative expressions should promote risk-avoidance. We return to the specific mechanisms in the discussion.

Emotion and risky decisions

Traditionally, decision making under risk has been viewed primarily as a cognitive process requiring integration of information about the probability and desirability of outcomes. Over the past decade, however, researchers began to emphasize the importance of emotion in decision (Loewenstein, Weber, Hsee, & Welch, 2001; Mellers, Schwartz, & Ritov, 1999; Slovic, Finucane, Peters, & MacGregor, 2002).

The role of emotion in risky decisions is highlighted by effects of lesions to the ventromedial prefrontal cortex (vmPFC) – a brain region involved in emotion (Damasio, 1994). Bechara et al. (1997) showed that, compared to controls, vmPFC-lesioned patients are more likely to choose gambles that are initially attractive, but subsequently associated with big losses, presumably because the patients lack affective feedback associated with big losses. VmPFC-lesioned patients can also make more profit-maximizing decisions. Shiv et al. (2005) demonstrated this using a myopic loss-aversion task involving repeated choices between a risky, but more profitable "invest" option, and a safe, but less profitable "do not invest" option (Gneezy & Potters, 1997). In this task it behooved participants to always invest because the expected value on each round was higher if they invested than if they did not ($1.25 vs. $1). Interestingly, compared to controls, vmPFC patients invested more frequently, presumably because they lack affective feedback associated with investment losses (Shiv et al., 2005).

Current Research

The current studies build upon previous work by exploring whether risky decisions are influenced by emotional cues, such as facial expressions. The current studies are important for several reasons.

Prior studies showed that facial expressions influence basic preferences (Winkielman et al., 2005). To our knowledge, the current studies are the first to explore whether these ubiquitous cues can influence more complex decisions under risk (Kahneman & Tversky, 1979).

Prior studies explored effects of hedonically undifferentiated feedback, such as arousal, in neurological patients (Bechara, 1997; Shiv et al., 2005). In contrast, we test a directional valence hypothesis, which predicts greater risk taking after viewing positive rather than negative facial expressions, in healthy participants.

Prior studies explored the effects of subjective feeling states, such as general positive and negative mood, or specific emotions such happiness, anger, or fear (Fessler, Pillsworth, & Flamson, 2004; Johnson & Tversky; 1983; Lerner & Keltner, 2001; Raghunathan & Pham, 1999). Accordingly, these studies used manipulations designed to elicit an enduring change in subjective feeling (e.g., recall of emotional memories, reading an evocative scenario, watching movies, or listening to music). Those studies also focused on how subjective feelings of the same valence, but different quality, can have distinct effects on risky decisions (e.g., feeling fearful increases risk perception whereas feeling angry decreases it, Lerner & Keltner, 2001).

In contrast, the current studies focus on the effects of implicit emotional cues, such as facial expressions. Based on previously mentioned work with facial expressions, and theoretical accounts of affective cue processing, we hypothesized that implicit emotional expressions would have a general valenced effect on risk decisions. To test this hypothesis, in two of our tasks we presented happy, neutral, angry and fearful expressions, and predicted that both fearful and angry expressions would decrease risk-seeking relative to happy expressions.

Current Paradigms

We examined these questions using three gambling tasks. Each task involved multiple trials in which participants were first presented with a facial expression and then chose between options that varied in risk. Study 1 employed a gambling task based on the myopic gambling paradigm described earlier. Study 2 employed two gambling tasks from the decision-making literature (described shortly) to examine the impact of emotional facial expressions across different (i) payoff structures, (ii) operationalizations of risk, (iii) temporal dimensions of the decision, and (iv) types of negative facial expressions.

Study 1

Study 1 used the myopic loss aversion task to examine whether emotional cues influence risky decisions of healthy participants in a valence-specific way (Gneezy & Potters, 1997; Shiv et al., 2005). We modified the task so that prior to each investment decision, participants were shown a face. To ensure that participants saw each face, they were asked to indicate its gender (male/female), but the faces also varied in emotional expression (angry, neutral, or happy). Because participants' goal was to maximize their account, the optimal strategy in this task is to invest on every round. However, we predicted that participants would fail to invest on some portion of the trials, replicating previous studies on myopic loss aversion. More importantly, we also predicted that the likelihood of investing on each trial would be influenced by the valence of the emotional expressions, with angry faces decreasing investing relative to happy faces.

We also examined whether the influence of emotional cues on gambling decisions occurred only when participants were informed about the immediate outcome of each gamble, or also when participants were informed about their cumulative wealth. This is interesting because the cumulative information might promote a more long-term strategy (Gneezy & Potters, 1997). Accordingly, on each trial, some participants received information only about the outcome of the current trial, whereas others also received information about their cumulative earnings. An effect of emotional cues on decisions in both conditions would suggest that their influence extends beyond situations involving consideration of only single gambles.

Method

Participants and procedure

Forty-seven undergraduates participated for course credit. Three participants (6%) were excluded from the analyses because they made the same response on each gambling trial (this does not change any effects).

Participants were tested individually using a computerized version of the myopic loss aversion paradigm (Figure 1, top panel). Participants were told that the experiment involved multiple trials of two separate but interleaved tasks: (i) a gender classification task, in which the goal was to perform as accurately as possible, and (ii) a gambling task, in which the goal was to earn as much play money as possible. In the gender classification task, a face appeared for 4 s followed by a question about its gender (male vs. female). Faces also varied in their emotional expression (angry, neutral, or happy, Ekman & Friesen, 1975). To ensure participants' engagement in the gender classification task, the faces were presented relatively briefly, and were cropped to remove obvious gender cues such as hair.

Each gender-classification trial was immediately followed by a gambling trial designed after Shiv et al. (2005). Beginning with an account of $20, participants decided on each round whether to invest $1 from their account for a 50% chance of winning an additional $1.50 vs. losing $1, or whether to pass on that round and keep $1 in the account (note that the expected value for investing equals $1.25, for passing $1, making investing the profit-maximizing choice). After each gambling decision, the computer displayed feedback with the trial outcome ($0 if pass, $1.50 if win, -$1 if loss). In addition, for some participants, the computer also displayed the cumulative total (e.g., $ 21.50 if the participant won on the first trial), before advancing to the next of 54 total trials.

Results

Preliminary Analyses

Participants classified gender accurately (90%) and quickly (884 ms), with no differences among valence conditions or feedback conditions (Fs < 1). Analyses of the gambling decisions replicated previous findings, showing that participants invested on the majority of trials (74%).

Main Analyses

To test our main hypothesis, we calculated the probability of investing as a function of the preceding facial expression (happy, neutral, angry) and the type of trial feedback (current trial only vs. current trial and total account). An ANOVA with valence (within subject) and feedback (between subjects) showed the expected main effect for valence, $F(2, 84) = 4.93$, $p < .01$, $\eta^2 = .11$. Simple tests (two-tailed for all tasks) revealed that participants invested less after angry then neutral faces, $t(43) = 2.22$, $p < .05$, and happy faces $t(43) = 2.4$, $p < .05$ (top panel of Figure 2). There were no main effects or interactions involving the feedback condition (all $Fs < 1$).

Discussion

Study 1 confirmed our prediction that emotional facial expressions influence gambling decisions. Viewing an angry face decreased the likelihood of investing on the subsequent trial, as compared to neutral and happy faces. This decrease is remarkable given that investing was beneficial from the profit-maximizing perspective. The lack of differences between happy and neutral faces is consistent with proposals that decisions in the myopic loss aversion task are primarily controlled by negative affect (Kahneman & Tversky, 1979; Shiv et al., 2005). The idea that participants approach the task with a "myopic" perspective, and thus become susceptible to momentary affective reactions, also fits well with our finding that emotional expressions influenced participants' subsequent decisions regardless of whether they received feedback about only the trial outcome or also their cumulative total.

Study 2

In Study 2, we addressed several conceptual issues using two different gambling tasks from the decision literature – the "3-Cards Task" and "Risky Gains Task", explained in detail shortly (Leland & Paulus, 2005; Paulus, Rogalsky, Simmons, Feinstein, & Stein, 2003).

First, we wanted to examine whether positive and negative expressions had a similar, valence-specific impact on risk decisions, even when risk taking is not the account-maximizing strategy. Specifically, in Study 1 the risky option had a higher expected value than the safe option. This raises the possibility that positive expressions promote risk seeking only when the risky option is inherently beneficial, perhaps due to evaluative matching (choosing options whose value matches the evaluative context, Musch & Klauer, 2003). To rule out this possibility the tasks in Study 2 used options with equal expected values.

Second, we examined whether facial expressions influence choices only between safe and risky options, or also among options that are all uncertain but that vary in degrees of risk (see Anderson, 2003 for discussion). Therefore, in the 3-Cards task, we manipulated risk by keeping the probability of each option the same, and varying the variance of outcomes, with the largest variance option by definition riskiest (Dickhaut et al. 2003). We expected that positive expressions would increase the probability of choosing the riskiest option.

Third, we examined whether emotional expressions would have similar effects even when the risky option is not a "default" choice. It is important to test this possibility because affective cues could influence both impulsive behavior (Gray, 1990) and amount of cognitive processing (Mackie & Worth, 1991). For example, in Study 1, negative expressions might have simply stopped participants from choosing the "default" (i.e., the initially considered option of investing). To address this possibility, the Risky Gains task in Study 2 presented options in a

sequential, rather than simultaneous fashion, with the safe option offered first, followed by risky options.

Fourth, we examined whether the influence of facial expressions depended upon general valence (positive vs. negative) or the specific emotional quality of the expression. Study 1 raises the possibility that greater risk aversion after viewing an angry face could be uniquely due to the emotion of anger, rather than to the general negative valence of the expression. To investigate this issue, we included an additional negative expression (fear) in both tasks of Study 2. We predicted that both fear and anger would have similar effects, consistent with idea that implicit facial expressions activate general positive and negative affect systems (Cacioppo & Berntson, 1999).

Finally, we addressed two side issues. To examine whether the effects generalize across different presentations of probabilities, in the 3-Cards task we informed participants about the exact likelihood of a win and a loss for each option, whereas in the Risky Gains task we left this information unspecified. Furthermore, to examine the possible role of subjective experience, in both tasks we asked participants to report whether the faces influenced their feelings. As discussed, based on previous research, we expected similar effects for participants who did and did not report changes in feelings (Winkielman et al., 2005a).

Method

Participants and Procedure

Twenty-four undergraduates participated for course credit. One participant (4%) was excluded for always choosing the same option (this does not change any results). Participants performed both the 3-Cards task and the Risky Gains task, with task order counterbalanced.

The structure of both tasks was similar to that of Study 1, with multiple trials of interleaved gender classifications and gambling decisions. For both tasks, participants were instructed to classify gender as accurately as possible, and to earn as many points as possible on the gambling portion, starting with the initial endowment of 1000 points. The gender classification portion for both tasks was similar to Study 1, except that fearful faces were presented in addition to angry, neutral, and happy faces. In addition, the duration of face presentation was adjusted to match the length of the respective gambling trial (4 seconds in the 3-Cards, 3 seconds in Risky Gains). The gambling portion immediately followed the gender decision and differed between the two tasks as described next.

The 3-Cards Task. Participants chose from three simultaneously presented options (Figure 1, center panel). Participants were informed that all options were equally probable (50%), but varied in how much could be won or lost. The options appeared for 4 s as gambles of 20/-20, 40/-40, and 80/-80 points. After participants made their choice, the computer displayed the outcome of the gamble and updated the total account, before advancing to the next of 55 total trials.

The Risky Gains Task. Participants chose from three sequentially presented options (Figure 1, bottom panel). Participants were told that the 20-point option was a sure win, whereas the 40- and 80-point options could win or lose 40 or 80 points, respectively. The options appeared in ascending order (20-40-80) for 1 s each. Unlike the other tasks, participants were not told the probabilities of the two risky options. The actual probabilities were such that each participant's final score was identical whether he or she selected the 20, 40, or 80 option. At the end of each trial, the computer displayed the outcome of the gamble and updated the total account, before advancing to the next of 96 total trials (see Paulus et al., 2003).

Results

Preliminary analyses

Because there were no main effects or interactions involving task order (*Fs* < 1.2), subsequent analyses collapse across this variable. In both tasks, gender classification was accurate (94% in 3-Cards and 93% in Risky Gains), relatively fast (1650 ms in 3-Cards and 1529 ms in Risky Gains), and did not vary by expression (*F*s < 1.4).

A post-experimental questionnaire given after each task asked: "Did the faces you were presented with have any influence on your feelings?" The 'yes' or 'no' response (48% yes in both tasks) did not moderate the impact of expressions (both *F*s < 1). The questionnaire also asked "What strategy and information did you use to gain the most points?" Seventy-nine percent of participants mentioned strategies unrelated to expressions. For both tasks, the response to this question did not moderate the impact of expressions (*F*s < 1).

3-Cards Task

This task examined whether facial expressions influence choice when all options are risky. Figure 2 (middle panel) graphs the probability of selecting the most and least risky option as a function of preceding expression. An ANOVA on the probability of choosing the riskiest option (+/-80) showed an overall effect for expression, $F(3,66) = 3.17$, $p < .05$, $\eta^2 = .13$. Participants were most likely to select the riskiest option after happy, relative to angry, $t(22) = 2.67$, $p < .05$, or, marginally, fearful expressions, $t(22) = 1.95$, $p = .06$, all tests two-tailed. An ANOVA on the least risky option (+/- 20) also showed an overall effect of expression, $F(3, 66) = 2.71$, $p = .05$, $\eta^2 = .11$. The probability of selecting the least risky option was smallest after an angry, $t(22) = 2.2$, $p < .05$ and, marginally, fearful, $t(22) = 1.92$, $p < .07$, relative to a happy

expression. There were no differences between effect of anger versus fear, and effects of expression on the medium-risk option (+/- 40).

Risky Gains Task

This task examined whether facial expression influence choice of a risky option even if it first requires bypassing a safe option. Figure 2 (bottom panel) graphs the probability of selecting the riskiest (80/-80) option and the safe (20) option as a function of the preceding expression. ANOVA on the riskiest option revealed a main effect of expression, $F(3, 66) = 4.58$, $p < .01$, $\eta^2 = .17$. Participants' probability to select the riskiest option was highest after happy than any other expression, all ts$(22) > 2.6$, all ps $< .05$. ANOVA on the safe option also revealed a main effect of expression, $F(3,66) = 3.04$, $p < .05$, $\eta^2 = .12$. Participants were more likely to choose the safe option after an angry, $t(22) = 2.71$, $p < .05$, or fearful $t(22) = 3.03$, $p < .01$, relative to happy expression. Again, there were no differences between effects of anger versus fear, and no effects of expression on the medium-risk option.

General Discussion

These studies demonstrate that the valence of emotional facial expressions influences risky decisions. Specifically, whereas positive expressions (happiness) increase the probability of a risky choice, negative expressions (anger and fear) decrease it. This effect is not specific to a particular task and can be observed with different types of payoff structures, risk operationalizations, time-demands and explicitly stated or unspecified outcome probabilities. Specifically, in the Invest/Pass task of Study 1, the risky option had a higher expected value than the safe option, but in the 3-Cards and Risky Gains tasks of Study 2, all options were equal. In the Invest/Pass and the Risky Gain tasks, participants chose between safe and risky options, whereas in the 3-Cards task, all options were uncertain, with risk depending on the variance of

outcomes. In the Invest/Pass and 3-Cards tasks, participants chose among options presented simultaneously, but in the Risky Gains task, participants chose sequentially, bypassing a safe option to select a risky option. Finally, in the Invest/Pass and the 3-Cards tasks, participants were explicitly informed about the probabilities, whereas in the Risky Gains task, probabilities were unspecified. In short, the effects of emotional facial expression appear quite robust.

Implications for Emotion and Decision

The current work corroborates and extends previous work on the role of emotion in decision-making. Earlier studies demonstrated that implicitly processed facial expressions influence simple judgments and behaviors (Winkielman et al., 2005a). Here we show that such expressions can influence complex risky decisions, such as choices of gambles. Other studies showed that neurological damage to mechanisms underling hedonically undifferentiated feedback can either impair or improve decisions (Bechara et al., 1997; Shiv et al., 2005). Here we show that in healthy participants, implicit emotional cues have valence-specific effects on risky decisions.

Our research also differs from earlier studies examining how inducing an enduring and qualitatively specific emotional feeling influences risky decisions (Fessler et al., 2004; Johnson & Tversky, 1983; Lerner & Keltner, 2001; Ragunathan & Pham, 1999). Such studies suggest that emotional feelings can influence risk taking by activating different cognitive appraisals (Lerner & Keltner, 2001), inferential mechanisms such as the “how-do-I-feel-about-it” heuristic (Ragunathan & Pham, 1999), or attempts at feeling regulation (Leith & Baumeister, 1996). Accordingly, such studies often report unique effects of specific feelings, such as anxiety, anger, sadness, or guilt. In contrast, our approach here explored the influence of basic facial expressions presented as task-irrelevant cues. As argued by several theorists, implicit processing of such

cues initially activates general positive and negative affect systems, accounting for a broad positive-negative impact observed in current studies (Cacioppo & Berntson, 1999; Lang, 1995; Russell, 2003). Of course, with more processing resources (e.g., attention or time), the effects of facial expressions should be more differentiated.

What are the precise mechanisms by which implicit facial expressions influence gambling? Expressions might lead to a generalized modification of propensity for exploratory behavior (Clore & Storbeck, in press), perhaps via operation of an "affect heuristic" (Slovic et al., 2002). Importantly, our data suggest a process that is relatively direct, rather than mediated via inferences from changes in subjective emotional experience. After all, in the current studies, as in previous research, the effects of facial expressions were not mediated by reports of feeling changes (Winkielman et al., 2005b). On a neural level, this process could involve facial expressions transiently influencing the incentive value of risky options via transient activation of subcortical circuits in the amygdala and nucleus accumbens and their connection to cortical representation of value (e.g., Kuhnen & Knutson, 2005). Future research should explore these and related questions, such as whether distinct affective mechanisms push participants toward or away from risky options, and whether similar effects would occur with other, non-facial emotional cues.

In conclusion, the current studies demonstrate that common social stimuli such as emotional facial expressions increase or decrease people's risky decisions, even when such expressions are processed implicitly. As such, this study contributes to the growing recognition that decision-making involves the interplay between emotional and cognitive processes.

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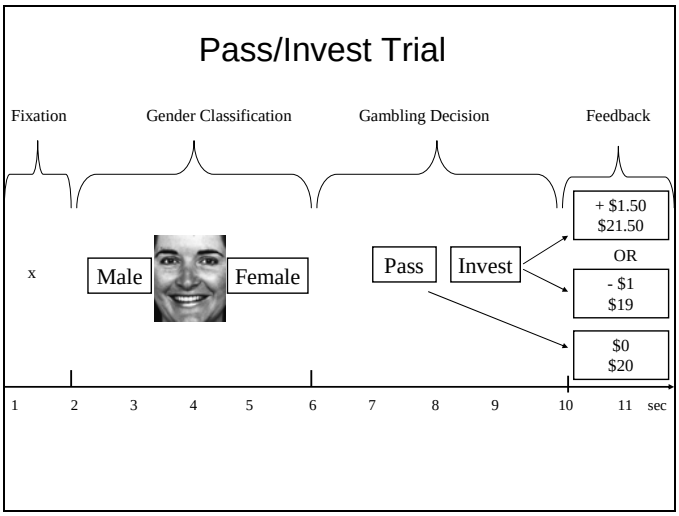
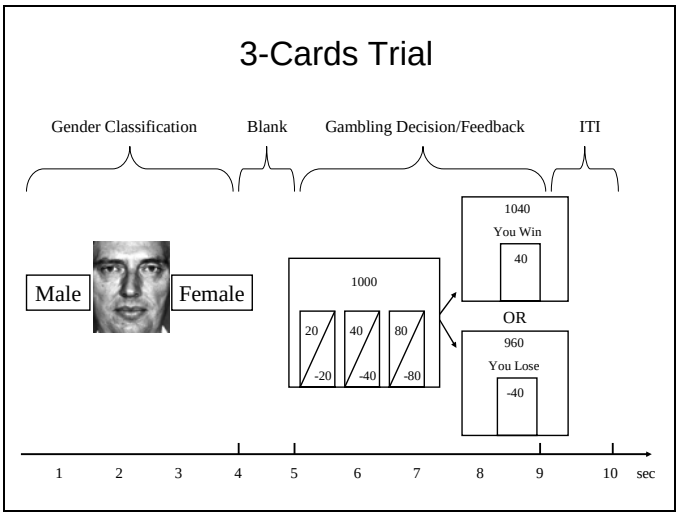
Figure Captions

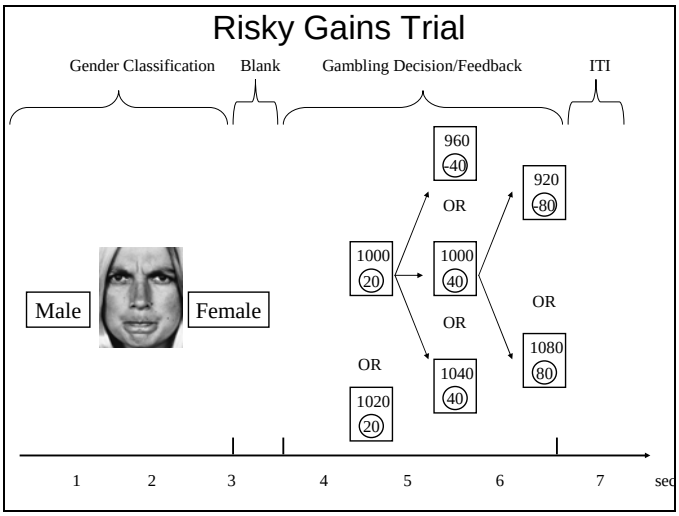
Figure 1. Trial time-course for Pass/Invest Task (top panel), 3-Cards Task (middle panel) and Risky Gains Task (bottom panel).

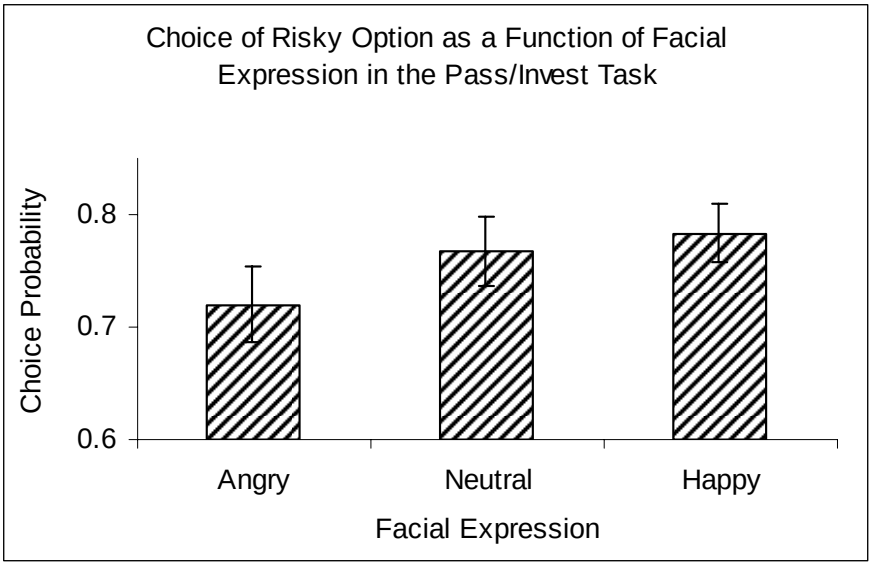
Note: The numbers in feedback events represent possible outcomes on the first trial.

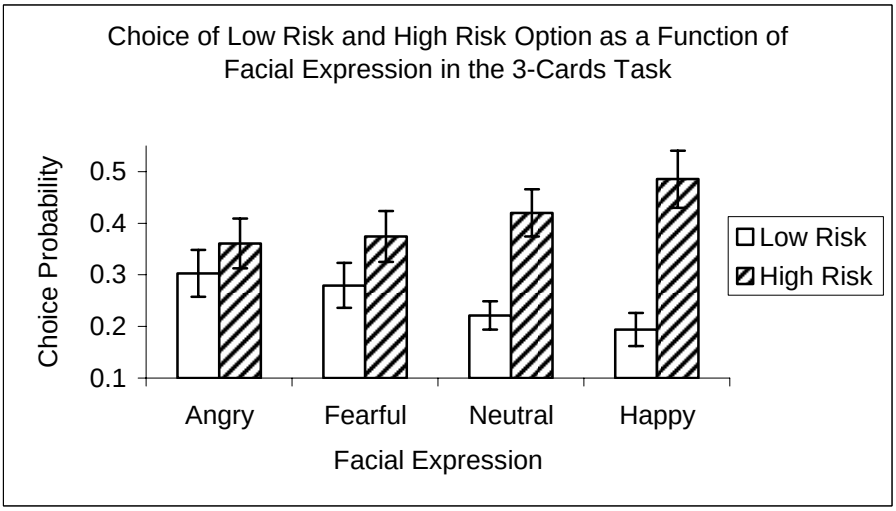
Figure 2. Means and standard errors of choice probability as a function of emotional facial expression in the Pass/Invest Task (top panel), 3-Cards Task (middle panel), and Risky Gains Task (bottom panel).

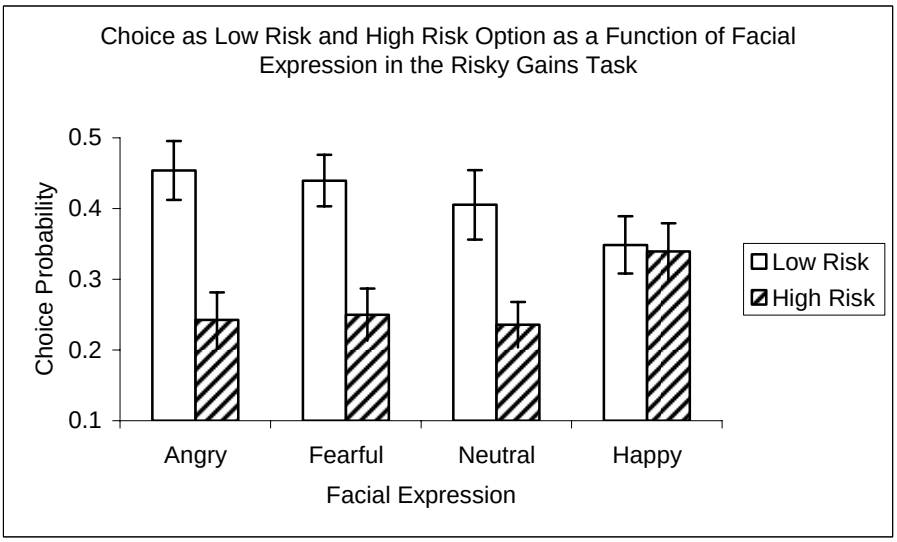

Pass/Invest Trial
Fixation
Gender Classification
Gambling Decision
Feedback
x
Male
Female
Pass
Invest
+ $1.50
$21.50
OR
- $1
$19
$0
$20
1 2 3 4 5 6 7 8 9 10 11 sec


3-Cards Trial
Gender Classification
Blank
Gambling Decision/Feedback
ITI
Male
Female
1000
20
-20
40
-40
80
-80
1040
You Win
40
OR
960
You Lose
-40
1 2 3 4 5 6 7 8 9 10 sec


Risky Gains Trial
Gender Classification
Blank
Gambling Decision/Feedback
ITI
Male
Female
1000
20
960
-40
OR
1000
40
920
-80
OR
OR
1040
40
1080
80
OR
1020
20
1 2 3 4 5 6 7 sec


Choice of Risky Option as a Function of Facial Expression in the Pass/Invest Task
Choice Probability
0.8
0.7
0.6
Angry
Neutral
Happy
Facial Expression


Choice of Low Risk and High Risk Option as a Function of Facial Expression in the 3-Cards Task
Choice Probability
0.5
0.4
0.3
0.2
0.1
Low Risk
High Risk
Angry
Fearful
Neutral
Happy
Facial Expression


Choice as Low Risk and High Risk Option as a Function of Facial Expression in the Risky Gains Task
Choice Probability
0.5
0.4
0.3
0.2
0.1
Low Risk
High Risk
Angry
Fearful
Neutral
Happy
Facial Expression